

**What is claimed is:**

- 1        1. A bonding pad structure, comprising:
  - 2            a substrate having a bonding region and a sensing region;
  - 4            a first dielectric layer formed overlying the substrate and having a dielectric island surrounded by a ring-shaped trench;
  - 7            a first conductive layer formed in the ring-shaped trench of the first dielectric layer;
  - 9            a passivation layer formed overlying the first dielectric layer and having an opening, wherein the opening corresponds to the bonding region and the sensing region and exposes the dielectric island and a part of the first conductive layer;  
14            and
  - 15          a second conductive layer covering the opening of the passivation layer and electrically connected to the first conductive layer.
- 1        2. The bonding pad structure as claimed in claim 1, wherein the substrate further comprises:
  - 3            a main area comprising an active area and a peripheral area;
  - 5            a first scribe line extending along a first direction;  
6            and
  - 7            a second scribe line extending along a second direction, wherein the intersection of the first scribe line and the second scribe line defines the main area;

11       wherein, the bonding pad structure is formed overlying  
12                  the active area, the peripheral area, the first  
13                  scribe line, the second scribe line or a  
14                  combination thereof.

1       3. The bonding pad structure as claimed in claim 2,  
2       wherein the bonding pad structures are arranged in a single  
3       line or staggered.

1       4. The bonding pad structure as claimed in claim 1,  
2       wherein the width of the first conductive layer is 1~50 $\mu$ m.

1       5. The bonding pad structure as claimed in claim 1,  
2       wherein the depth of the first conductive layer is 0.5~2 $\mu$ m.

1       6. The bonding pad structure as claimed in claim 1,  
2       wherein a measurement ratio  $R_1$  satisfies the formula:  $R_1 =$   
3        $A_r/A_s$  and  $0 \leq R_1 \leq 30\%$  , where  $A_r$  is an area of the first  
4       conductive layer within the sensing region, and  $A_s$  is the  
5       area of the sensing region.

1       7. The bonding pad structure as claimed in claim 1,  
2       further comprising:

3                  a second dielectric layer formed underlying the first  
4                  dielectric layer;  
5                  a third conductive layer formed in the second  
6                  dielectric layer; and  
7                  at least one conductive plug formed in the second  
8                  dielectric layer and electrically connecting the  
9                  third conductive layer to the first conductive  
10                 layer.

1       8. The bonding pad structure as claimed in claim 7,  
2 wherein the third conductive layer is a ring, a lattice  
3 form, an array of islands or a solid form.

1       9. The bonding pad structure as claimed in claim 1,  
2 wherein the trench of the first dielectric layer is a  
3 quadrilateral ring, a circular ring, a hexagonal ring, an  
4 octagonal ring or a polygonal ring.

1       10. The bonding pad structure as claimed in claim 1,  
2 wherein the first conductive layer is a quadrilateral ring,  
3 a circular ring, a hexagonal ring, an octagonal ring or a  
4 polygonal ring.

1       11. The bonding pad structure as claimed in claim 1,  
2 wherein the second conductive layer is a quadrilateral  
3 solid, a circular solid, a hexagonal solid, an octagonal  
4 solid or a polygonal solid.

1       12. The bonding pad structure as claimed in claim 1,  
2 further comprising at least one corner cut portion adjacent  
3 to at least one corner of the first conductive layer,  
4 wherein the corner cut portion prohibits the formation of  
5 the first conductive layer and allows the formation of the  
6 first dielectric layer.

1       13. The bonding pad structure as claimed in claim 12,  
2 wherein the corner cut portion is a right triangle, the  
3 hypotenuse length of the right triangle is 0.5~5 $\mu$ m, and an  
4 included angle  $\theta_1$  between the hypotenuse and x axis is  
5 10°~80°.

1       14. The bonding pad structure as claimed in claim 12,  
2 wherein a measurement ratio  $R_2$  satisfies the formula:  $R_2 =$   
3  $A_{t1}/A_{c1}$ ,  $A_{c1} = W_1 \times W_2$ , and  $0 < R_2 < 80\%$ , where  $A_{t1}$  is the area of the  
4 corner cut portion,  $A_{c1}$  is the corner area of the first  
5 conductive layer,  $W_1$  is a first-direction width of the  
6 corner area of the first conductive layer is a second-  
7 direction width of the corner area of the first conductive  
8 layer.

1       15. The bonding pad structure as claimed in claim 1,  
2 further comprising at least one corner cut portion adjacent  
3 to at least one corner of the second conductive layer,  
4 wherein the corner cut portion prohibits the formation of  
5 the second conductive layer and allows the formation of the  
6 passivation layer.

1       16. The bonding pad structure as claimed in claim 15,  
2 wherein the corner cut portion is a right triangle, the  
3 hypotenuse length of the right triangle is  $0.5\text{--}10\mu\text{m}$ , and an  
4 included angle  $\theta_1$  between the hypotenuse and X axis is  
5  $10^\circ\text{--}80^\circ$ .

1       17. The bonding pad structure as claimed in claim 1,  
2 wherein the first conductive layer further comprises at  
3 least one marking notch which delineates the sensing region  
4 from the bonding region.

1       18. The bonding pad structure as claimed in claim 17,  
2 wherein the marking notch of the first conductive layer  
3 comprises a bottom side and two lateral sides which surround  
4 the first dielectric layer to define a dielectric marking.

1       19. The bonding pad structure as claimed in claim 18,  
2       wherein a first length of the dielectric marking parallel to  
3       the bottom side of the marking notch is 1~3 $\mu$ m, and a second  
4       length of the dielectric marking parallel to the lateral  
5       side of the marking notch is 0.5~2 $\mu$ m.

1       20. The bonding pad structure as claimed in claim 1,  
2       wherein the second conductive layer further comprises at  
3       least one marking notch which delineates the sensing region  
4       from the bonding region.

1       21. The bonding pad structure as claimed in claim 20,  
2       wherein the marking notch of the second conductive layer  
3       comprises a bottom side and two lateral sides which surround  
4       the passivation dielectric layer to define a passivation  
5       marking.

1       22. The bonding pad structure as claimed in claim 21,  
2       wherein a first length of the passivation marking parallel  
3       to the bottom side of the marking notch is 1~3 $\mu$ m, and a  
4       second length of the passivation marking parallel to the  
5       lateral side of the marking notch is 0.5~2 $\mu$ m.

1       23. The bonding pad structure as claimed in claim 1,  
2       further comprising:

3           an extension portion of the first conductive layer  
4           extending away from the bonding region and the  
5           sensing region; and  
6           a circuit under pad (CUP) scheme formed underlying the  
7           extension portion of the first conductive layer.

1       24. The bonding pad structure as claimed in claim 23,  
2 wherein the circuit under pad (CUP) scheme comprises:

3           a circuit scheme formed underlying the extension  
4           portion of the first conductive layer; and  
5           a plurality of conductive plugs electrically connecting  
6           the circuit scheme to the extension portion of  
7           the first conductive layer.

1       25. The bonding pad structure as claimed in claim 24,  
2 wherein the circuit under pad (CUP) scheme comprises:

3           a buffer layer formed underlying the first dielectric  
4           layer, wherein the circuit scheme is formed in  
5           the buffer layer; and  
6           a plurality of via holes formed in the first dielectric  
7           layer and underlying the extension portion of the  
8           first conductive layer, wherein the conductive  
9           plugs are formed in the via holes respectively.

1       26. The bonding pad structure as claimed in claim 24,  
2 wherein the circuit under pad (CUP) scheme comprises:

3           a plurality of via holes formed in the first dielectric  
4           layer and underlying the extension portion of the  
5           first conductive layer,  
6           wherein the conductive plugs are formed in the via  
7           holes respectively; and  
8           wherein the circuit scheme is formed in the first  
9           dielectric layer and underlying the conductive  
10          plugs.

1       27. The bonding pad structure as claimed in claim 23,  
2 wherein the circuit under pad (CUP) scheme comprises:  
3            a second dielectric layer formed underlying the first  
4            dielectric layer;  
5            a third conductive layer formed in the second  
6            dielectric layer and electrically connected to  
7            the first conductive layer;  
8            an extension portion of the third conductive layer  
9            extending away from the bonding region and the  
10          sensing region;  
11          a buffer layer formed underlying the second dielectric  
12          layer;  
13          a circuit scheme formed in the buffer layer; and  
14          a plurality conductive plugs electrically connecting  
15            the circuit scheme to the extension portion of  
16            the third conductive layer.

1       28. The bonding pad structure as claimed in claim 27,  
2 wherein the third conductive layer is a ring, a lattice  
3 form, an array of islands or a solid form.

1       29. The bonding pad structure as claimed in claim 1,  
2 further comprising a bonding element formed overlying the  
3 second conductive layer within the bonding region.

1       30. The bonding pad structure as claimed in claim 29,  
2 wherein the bonding element is a conductive ball or a  
3 conductive bump.

1       31. The bonding pad structure as claimed in claim 1,  
2 further comprising a barrier layer formed between the first  
3 conductive layer and the second conductive layer.

1       32. The bonding pad structure as claimed in claim 31,  
2 wherein the barrier layer is Ti, TiN, W, WN, Ta, TaN or a  
3 combination thereof.

1       33. The bonding pad structure as claimed in claim 1,  
2 wherein the first conductive layer is copper (Cu), aluminum  
3 (Al), AlCu alloy, a copper manganese alloy or a copper-  
4 containing alloy.

1       34. The bonding pad structure as claimed in claim 1,  
2 wherein the second conductive layer is aluminum (Al), AlCu  
3 alloy or an aluminum-containing alloy.

1       35. The bonding pad structure as claimed in claim 1,  
2 wherein the first dielectric layer is plasma oxide, HDP  
3 oxide, dielectric with high resistance to mechanical stress,  
4 low-k dielectrics, fluorinated silicate glass (FSG) or  
5 silicon-based dielectrics.

1       36. A bonding pad structure, comprising:  
2            a substrate having a bonding region and a sensing  
3            region;  
4            a first dielectric layer formed overlying the substrate  
5            and having a trench;  
6            a first conductive layer formed in the trench of the  
7            first dielectric layer;

8        a passivation layer formed overlying the first  
9           dielectric layer and having an opening  
10          corresponding to the bonding region, wherein the  
11          passivation layer covers the first conductive  
12          layer formed within the sensing region; and  
13        a second conductive layer covering the opening of the  
14           passivation layer and formed overlying the  
15          sensing region, wherein the second conductive  
16          layer is electrically connected to the first  
17          conductive layer.

1        37. The bonding pad structure as claimed in claim 36,  
2        wherein the substrate further comprises:

3            a main area comprising an active area and a peripheral  
4            area;  
5            a first scribe line extending along a first direction;  
6            and  
7            a second scribe line extending along a second  
8            direction, wherein the intersection of the first  
9            scribe line and the second scribe line defines  
10          the main area;  
11        wherein, the bonding pad structure is formed overlying  
12            the active area, the peripheral area, the first  
13            scribe line, the second scribe line or a  
14            combination thereof.

1        38. The bonding pad structure as claimed in claim 37,  
2        wherein the bonding pad structures are arranged in a single  
3        line or staggered.

1       39. The bonding pad structure as claimed in claim 36,  
2 wherein the width of the first conductive layer is 1~50 $\mu$ m.

1       40. The bonding pad structure as claimed in claim 36,  
2 wherein the depth of the first conductive layer is 0.5~2 $\mu$ m.

1       41. The bonding pad structure as claimed in claim 36,  
2 wherein the first conductive layer is a ring, a lattice  
3 form, an array of islands or a solid form.

1       42. The bonding pad structure as claimed in claim 36,  
2 wherein the trench of the first dielectric layer is a ring,  
3 a lattice form, an array of islands or a solid form.

1       43. The bonding pad structure as claimed in claim 36,  
2 further comprising:

3            a second dielectric layer formed underlying the first  
4            dielectric layer;  
5            a third conductive layer formed in the second  
6            dielectric layer; and  
7            at least one conductive plug formed in the second  
8            dielectric layer and electrically connecting the  
9            third conductive layer to the first conductive  
10          layer.

1       44. The bonding pad structure as claimed in claim 43,  
2 wherein the third conductive layer is a ring, a lattice  
3 form, an array of islands or a solid form.

1       45. The bonding pad structure as claimed in claim 36,  
2 wherein the second conductive layer is a quadrilateral  
3 solid, a circular solid, a hexagonal solid, an octagonal  
4 solid or a polygonal solid.

1       46. The bonding pad structure as claimed in claim 36,  
2 further comprising at least one corner cut portion adjacent  
3 to at least one corner of the first conductive layer,  
4 wherein the corner cut portion prohibits the formation of  
5 the first conductive layer and allows the formation of the  
6 first dielectric layer.

1       47. The bonding pad structure as claimed in claim 46,  
2 wherein the corner cut portion is a right triangle, the  
3 hypotenuse length of the right triangle is  $0.5\text{--}5\mu\text{m}$ , and an  
4 included angle  $\theta_1$  between the hypotenuse and X axis is  
5  $10^\circ\text{--}80^\circ$ .

1       48. The bonding pad structure as claimed in claim 46,  
2 wherein a measurement ratio  $R_2$  satisfies the formula:  $R_2 =$   
3  $A_{t1}/A_{c1}$ ,  $A_{c1}=W_1 \times W_2$ , and  $0 < R_2 < 80\%$ , where  $A_{t1}$  is the area of the  
4 corner cut portion,  $A_{c1}$  is the corner area of the first  
5 conductive layer,  $W_1$  is a first-direction width of the  
6 corner area of the first conductive layer is a second-  
7 direction width of the corner area of the first conductive  
8 layer.

1       49. The bonding pad structure as claimed in claim 36,  
2 further comprising at least one corner cut portion adjacent  
3 to at least one corner of the second conductive layer,  
4 wherein the corner cut portion prohibits the formation of

5 the second conductive layer and allows the formation of the  
6 passivation layer.

1       50. The bonding pad structure as claimed in claim 49,  
2 wherein the corner cut portion is a right triangle, the  
3 hypotenuse length of the right triangle is 0.5~10 $\mu\text{m}$ , and an  
4 included angle  $\theta_1$  between the hypotenuse and X axis is  
5 10°~80°.

1       51. The bonding pad structure as claimed in claim 36,  
2 wherein the first conductive layer further comprises at  
3 least one marking notch which discriminates the sensing  
4 region from the bonding region.

1       52. The bonding pad structure as claimed in claim 51,  
2 wherein the marking notch of the first conductive layer  
3 comprises a bottom side and two lateral sides which surround  
4 the first dielectric layer to define a dielectric marking.

1       53. The bonding pad structure as claimed in claim 52,  
2 wherein a first length of the dielectric marking parallel to  
3 the bottom side of the marking notch is 1~3 $\mu\text{m}$ , and a second  
4 length of the dielectric marking parallel to the lateral  
5 side of the marking notch is 0.5~2 $\mu\text{m}$ .

1       54. The bonding pad structure as claimed in claim 36,  
2 wherein the second conductive layer further comprises at  
3 least one marking notch which discriminates the sensing  
4 region from the bonding region.

1       55. The bonding pad structure as claimed in claim 54,  
2 wherein the marking notch of the second conductive layer

3 comprises a bottom side and two lateral sides which surround  
4 the passivation dielectric layer to define a passivation  
5 marking.

1       56. The bonding pad structure as claimed in claim 55,  
2 wherein a first length of the passivation marking parallel  
3 to the bottom side of the marking notch is 1~3 $\mu$ m, and a  
4 second length of the passivation marking parallel to the  
5 lateral side of the marking notch is 0.5~2 $\mu$ m.

1       57. The bonding pad structure as claimed in claim 36,  
2 further comprising:

3           an extension portion of the first conductive layer  
4           extending away from the bonding region and the  
5           sensing region; and  
6           a circuit under pad (CUP) scheme formed underlying the  
7           extension portion of the first conductive layer.

1       58. The bonding pad structure as claimed in claim 57,  
2 wherein the circuit under pad (CUP) scheme comprises:

3           a circuit scheme formed underlying the extension  
4           portion of the first conductive layer; and  
5           a plurality of conductive plugs electrically connecting  
6           the circuit scheme to the extension portion of  
7           the first conductive layer.

1       59. The bonding pad structure as claimed in claim 58,  
2 wherein the circuit under pad (CUP) scheme comprises:

3           a buffer layer formed underlying the first dielectric  
4           layer, wherein the circuit scheme is formed in  
5           the buffer layer; and

6       a plurality of via holes formed in the first dielectric  
7              layer and underlying the extension portion of the  
8              first conductive layer, wherein the conductive  
9              plugs are formed in the via holes respectively.

1       60. The bonding pad structure as claimed in claim 58,  
2       wherein the circuit under pad (CUP) scheme comprises:

3              a plurality of via holes formed in the first dielectric  
4              layer and underlying the extension portion of the  
5              first conductive layer,  
6              wherein the conductive plugs are formed in the via  
7              holes respectively; and  
8              wherein the circuit scheme is formed in the first  
9              dielectric layer and underlying the conductive  
10             plugs.

1       61. The bonding pad structure as claimed in claim 57,  
2       wherein the circuit under pad (CUP) scheme comprises:

3              a second dielectric layer formed underlying the first  
4              dielectric layer;  
5              a third conductive layer formed in the second  
6              dielectric layer and electrically connected to  
7              the first conductive layer;  
8              an extension portion of the third conductive layer  
9              extending away from the bonding region and the  
10             sensing region;  
11             a buffer layer formed underlying the second dielectric  
12             layer;  
13             a circuit scheme formed in the buffer layer; and

14           a plurality conductive plugs electrically connecting  
15           the circuit scheme to the extension portion of  
16           the third conductive layer.

1           62. The bonding pad structure as claimed in claim 61,  
2       wherein the third conductive layer is a ring, a lattice  
3       form, an array of islands or a solid form.

1           63. The bonding pad structure as claimed in claim 36,  
2       further comprising a bonding element formed overlying the  
3       second conductive layer within the bonding region.

1           64. The bonding pad structure as claimed in claim 63,  
2       wherein the bonding element is a conductive ball or a  
3       conductive bump.

1           65. The bonding pad structure as claimed in claim 36,  
2       further comprising a barrier layer formed between the first  
3       conductive layer and the second conductive layer.

1           66. The bonding pad structure as claimed in claim 65,  
2       wherein the barrier layer is Ti, TiN, W, WN, Ta, TaN or a  
3       combination thereof.

1           67. The bonding pad structure as claimed in claim 36,  
2       wherein the first conductive layer is copper (Cu), aluminum  
3       (Al), AlCu alloy, a copper manganese alloy, or a copper-  
4       containing alloy.

1           68. The bonding pad structure as claimed in claim 36,  
2       wherein the second conductive layer is aluminum (Al), AlCu  
3       alloy or an aluminum-containing alloy.

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1       69. The bonding pad structure as claimed in claim 36,  
2 wherein the first dielectric layer is plasma oxide, HDP  
3 oxide, dielectric with high resistance to mechanical stress,  
4 low-k dielectrics, fluorinated silicate glass (FSG) or  
5 silicon-based dielectrics.